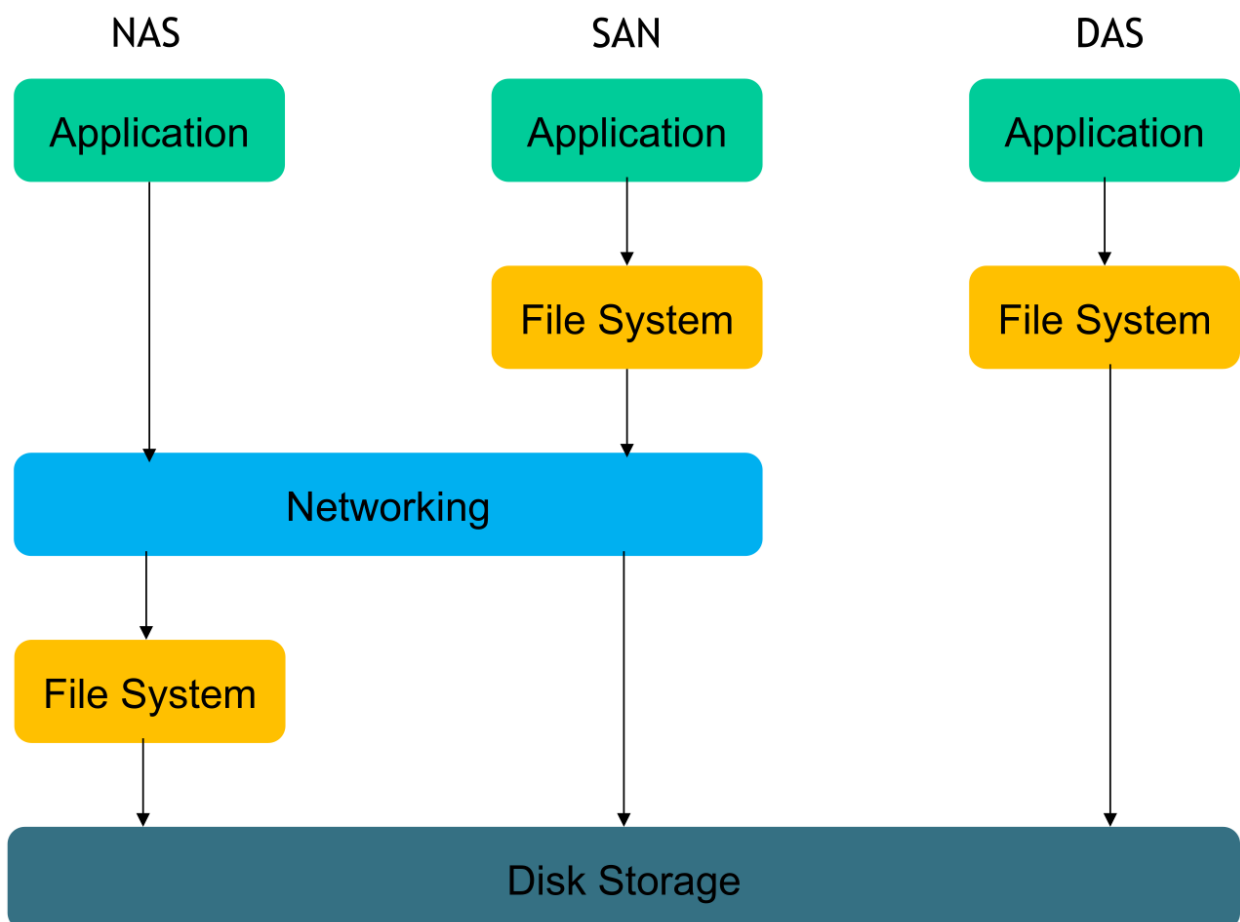


Storage systems

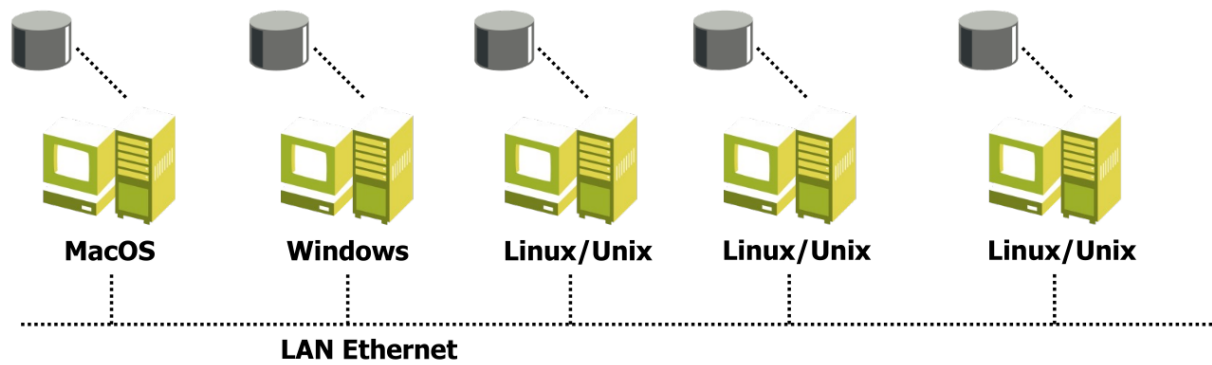
There are three main types of storage solutions for data centres:

- **Direct Attached Storage (DAS):** a storage system that is directly attached to a server or workstation. The operating system sees the disks in the DAS as disks attached to the system.
- **Network Attached Storage (NAS):** a computer connected to a network that provides file-based data storage services, such as FTP, NFS and SAMBA, to other devices on the network. The operating system of a server or workstation sees a NAS as a file server.
- **Storage Area Network (SAN):** a remote storage unit that is connected to a server using specific networking technology and is visible as disks directly attached to the server by its OS.



Direct Attached Storage (DAS)

A Direct Attached Storage is a storage system that is directly attached to a server or workstation. The term is used to differentiate non-networked storage from other storage systems, like NAS or SAN.



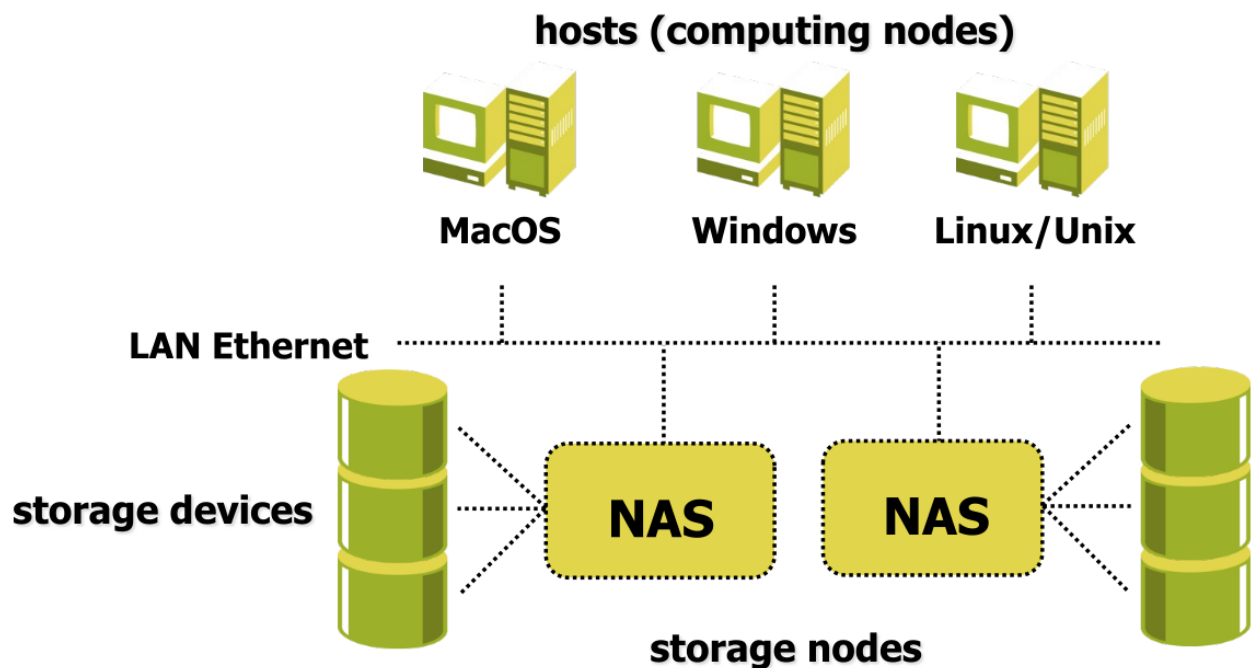
When speaking of Direct Attached Storage, we don't necessarily mean internal drives inside a server or workstation: all external disks connected with a point-to-point protocol to a PC can be considered DAS.

Direct Attached Storage has some problems:

- It scalability is limited
- It management can be complex
- In order to read files on other machines, the OS's file sharing protocol must be enabled

Network Attached Storage (NAS)

A Network Attached Storage unit is a computer connected to a network that provides only file-based data storage services to other devices on the network. NAS systems contain one or more hard disks, often organised in a RAID configuration, and provide file-access services to the hosts connected to it via a TCP/IP network through different protocols, like FTP, NFS or SAMBA.



Each NAS unit has its own IP address on the network, which makes scalability more flexible: in order to increase storage capacity, one could either add disks to a single NAS or add another NAS entirely.

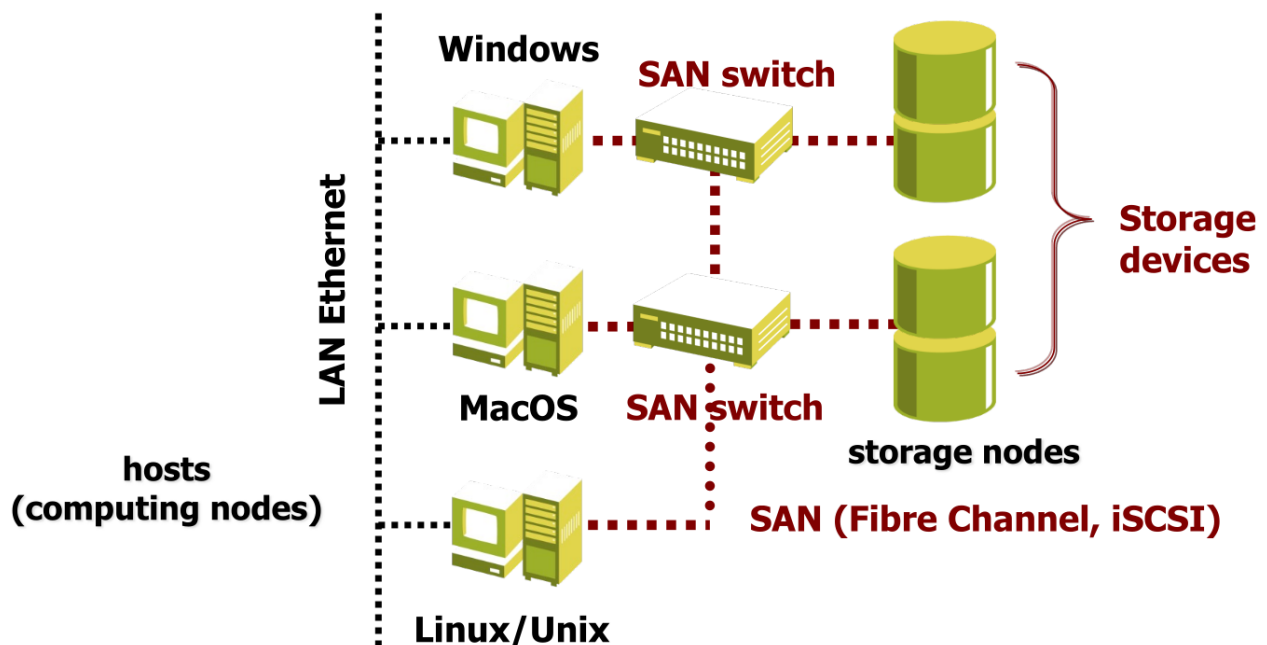
The key difference between a NAS and a DAS unit is that while a DAS is simply an extension of an existing server, a NAS is designed as a self-contained solution for sharing files over the network.

One key issue with NAS systems is that the performance of a NAS mainly depends on the speed and congestion of the network the system is in.

Storage Area Network (SAN)

Storage Area Networks are remote storage units that are connected to a server or workstation using a specific networking technology, like fibre optics.

SANs usually employ a special network to access their storage devices. This means that while the SANs communicate via TCP/IP with other devices, they use a dedicated network just to read and write data. This provides great scalability, since to increase storage capacity it's sufficient to increase the number of disks attached to the SAN.



The main difference between NAS and SAN is that, while a NAS also provides a file system, disks available through SAN appear as normal, directly attached disks to its users.

Traditionally, NAS systems are used for low-volume access to a large amount of storage by many users, while SAN system are a solution for petabytes of storage and multiple, simultaneous access to files, such audio and video streaming.

Summing up

Below is a table condensing the main information about the three storage solutions seen above.

Storage solution	Application domain	Advantages	Disadvantages
DAS	When a simple and cost-effective solution is required	Easy setup, low cost, high performance	Limited accessibility, limited scalability, no central management and backup
NAS	When it is necessary to store and share a large quantity of data	Scalable, very accessible, good performance on a fast network	Increased LAN traffic, transfer speeds are limited by the network
SAN	Mainly used for virtualised environments and DBMSs	Very good performance, great scalability, improved availability compared to NAS	High costs, complex setup and maintenance